Amendments to the Specification:

[0002] Image publishing systems are widely used to distribute images from a centralized server computer connected to a network to users that are also connected to the network. The images are generated by ~~some~~ an image source and stored in a centralized database connected to the server computer. Users at client computers make requests for images to the server computer. The server computer, in response to the requests, sends image data over the network to the user at the client computer.

[0006] Since typical medical images, e.g., radiological images, are relatively large files, ~~i.e.~~ e.g., tens of megabytes, it would take a relatively long time to transmit entire images to users located remotely from the centralized PACS server and connected using slow speed communications.

[0007] A disadvantage of a conventional PACS system is that image distribution is performed manually. An image source generates an image where it is stored on an image archive or storage facility connected to the server. Once it is stored, a user, ~~i.e.~~ e.g., physician, at a viewing station or client computer must manually request to view the image. The client computer generates a request and sends it to the PACS server. In response to the request, the server retrieves the image from the image database and transmits it to the client computer. A problem arises in that many times, users do not know when an image becomes available for viewing. There is typically a lag between the time when the image is actually available and the time when the user is aware of this fact and requests the image to be transferred. This is inefficient in terms of time since a physician, for example, would typically like to be able to view the images as soon at they are available.

[0010] Conventional PACS systems perform medical image transfer by sending the entire study data from the image storage location to the user's client workstation. Depending on bandwidth availability~~,~~ and compression ratios, this may take hours to complete over a slow network connection, e.g., dial-up line, creating a tradeoff between speed of delivery and degree of image quality. Further, the contents of a study cannot be viewed until ~~all its data~~ the entire study is completely received by the client computer or viewing station. In the case of a large study, this

is inefficient and undesirable because the physician must wait for the entire contents of a study to be received before being able to view any of the images within the study.

[0011] Therefore, there is a need for an image publishing system with improved distribution over slow WAN communication connections. It is desirable that such a system provides some form of data pushing whereby studies (or ~~image~~ images) are immediately sent to users automatically once they become available on the server. It is also desirable that the image publishing system has the capability of overcoming the limitation imposed by slow WAN connections. It is further desirable that the image publishing system permits users to view the contents of a study or image before data transmission for that study or image is complete.

[0034] The present invention provides an image publishing system that overcomes the disadvantages and problems of the prior art. The system comprises a distribution mechanism whereby images are forwarded automatically to users in accordance with a set of publication rules. The rules determine which images are to be sent to which users. The images are forwarded to users as they become available on an image archive storage device. This overcomes the requirement of users having to manually request the transmission of each individual image they ~~would like~~ wish to view.

[0037] The image publishing system of the present invention is applicable to a side variety of fields and disciplines such as medical imaging, teleradiology, graphic arts, printing, publishing, etc. For illustration purposes only, the present invention is described in the context of a medical imaging application. In particular, a PACS system used to store, distribute and view studies containing radiological images, text based reports, etc. It is appreciated by one skilled in the art that the invention is not limited to the example PACS system described herein but can be applied to numerous other fields and disciplines without departing from the spirit and scope of the invention. It is noted that the present invention is applicable in any system whereby data is distributed (or published) to a plurality of users and it is desirable to give users the ability to view any image queued for transmission before it ~~have~~ has been completely received at a user's client computer. It is also noted that the present invention is not limited for use with any particular

computer system, communication network, type or contents of study, image, etc., communications protocol, image format or progressive image streaming technique.

[0039] A block diagram illustrating an example network including server and client computers constructed in accordance with the principles of the present invention and connected to a wide area network such as the Internet is shown in Figure 1. The example network 10, comprises the various components of the image publishing system. The system comprises several portions including a server portion, communication network and client portion. The server portion comprises a publication server 14, study source 15, publishing rules 13, study storage 12, publication server cache 16 and web server 18. The system may also include a system administrator 23 in communication with the client computers and server computers via the communications network 22. The client portion comprises one or more client computers 24 comprising a web browser 30 with publication client 26 and cache 28. The client computers and web server 18 are in communication with each other and to other computers through a communications network 22 such as the Internet, Intranet, local area network (LAN), wide area network (WAN), metropolitan area network (MAN), wireless network, etc. It is appreciated by those skilled in the art that a variety of communication ~~network~~ networks may be used to implement the present invention.

[0053] A key feature of the iPACS software is the OnCall button feature. When a user presses the OnCall button, the client computer enters the OnCall mode and the OnCall display window is opened. The OnCall mode is actually an automatic mode of operation for retrieving studies from the publication server as they become available without any intervention by a user. To configure the system for automatic transmission of studies, the publication rules are modified such that new studies that fit particular criteria are automatically sent to the particular user. The actual rules may be based on any suitable criteria and ~~is~~ are not ~~relevant~~ critical to operation of the invention. For example, the criteria may include the patient name, particular body part, particular referring physician, date, time, etc. The rules may be set statically a priori or they may be set dynamically by the user or system administrator.

[0057] A key feature of the present invention is the ability of a user to immediately view the contents of a study regardless of the percentage of data received for that study at that point in time. A study can be immediately viewed by clicking on the View Study icon 112 for the particular study of interest. In response, a viewer window opens and the contents (e.g., images) of the study are displayed. Transmission of study data for the non-selected studies still continues but a higher priority is given to any requests for data of the selected study.

[0071] Note that when a study is to be transmitted from the publication server to client computers, a transmission of the study contents (e.g., images) using progressive image streaming is initiated such that the information is sent in encoded layers of increasing accuracy and quality. Typically, the progressive image streaming occurs using a lossless mode whereby the accuracy of the data being sent ~~increased~~ increases in accuracy until lossless accuracy is achieved.

[0075] A flow diagram illustrating a second method of activating the OnCall feature using push functionality is shown in Figures 8A and 8B. This method is similar to that of the method of Figures 7A and 7B with the difference being that a push functionality is issued to automatically transmit new study data to client computers rather than pull functionality. Initially, the user first logs into the iPACS study browser (step 150). This step logs the user ~~into~~ onto the publication server. A display window similar to that of Figure 4 opens on the client computer. The user then clicks ~~on~~ the OnCall button to enter the automatic transmission mode or OnCall mode in this example (step 152). The client software opens the OnCall window (step 154). The display window shown at this point is similar to that shown in Figure 5.

[0081] It is important to note that in both the pull and push methods of activating the OnCall mode, the client/server protocol used to transmit study data is the same regardless of the mode of operation. The same client/server protocol (i.e. progressive image streaming) is used whether the system is in automatic publishing mode (i.e. OnCall) or in interactive viewing mode. It is the use of the same protocol for both automatic and interactive modes that enables a user to switch transparently back and forth between publishing mode and interactive mode at any time. When a study is selected for viewing in interactive mode, all data present in the client computer at that

time is used to display the image. Any data retrieved during interactive mode is not retrieved again after switching back to automatic mode. Once automatic mode resumes, the process of retrieving study data for all queued studies continues. Any data already retrieved for a study while in interactive mode is utilized and does not need to be resent from the publication server.

[0082] Thus, the background task of retrieving study data for all queued studies continues regardless of the fact that the user may have ~~switching~~ switched to interactive mode. While in interactive mode, the data retrieval process continues while higher priority is given to any requests made by the user to view specific regions of interest of an image. Depending on several factors including available bandwidth, etc. the background data retrieval may be halted while the requests for ROIs are being handled. While no requests for additional specific ROIs are being made (such as while the physician is viewing and analyzing the image data already received) the background data retrieval task to transfer the remainder of the queued studies continues.

[0083] A flow diagram illustrating a first method of canceling the OnCall feature that uses pull functionality is shown in Figure 9. Initially, the user clicks on the Cancel OnCall button 104 while the OnCall display window is open (Figure 5) (step 180). In response to the button press, the client computer ~~closed~~ closes the OnCall window (step 182) and ceases periodic polling of the publication server for new studies (step 184). Data reception for any studies outstanding (i.e. data reception not complete) also ceases and operation of the client application returns to what it was before OnCall mode was entered (step 186).

[0084] A flow diagram illustrating a second method of canceling the OnCall feature that uses push functionality is shown in Figure 10. Initially, the user clicks on the Cancel OnCall button 104 while the OnCall display window is open (Figure 5) (step 190). In response to the button press, the client computer ~~closed~~ closes the OnCall window (step 192). The client computer generates and sends a message to the publication server to cease pushing study data (step 194). Data reception for any studies outstanding (i.e. data reception not complete) ceases and operation of the client application returns to what it was before OnCall mode was entered (step 196).